

SPICE Standards Facilitate Astrodynamics Tasks

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NASA's "SPICE" ancillary information system standards are widely used in the NASA space exploration community in support of end-to-end information system needs. This includes a variety of uses associated with the astrodynamics segment of the community, both for internal purposes and as a means of providing results to other groups involved in flight projects or space science endeavors in general. As currently implemented, SPICE data components address items such as ephemerides of natural bodies, trajectories and orientations of space vehicles, orientation of space vehicles (or parts thereof), selected physical and cartographic data associated with natural bodies, specification and chaining of a multitude of reference frames, and time conversions. Special extensions and adaptations of some SPICE components provide high precision location and orientation of topographic stations such as those of NASA's Deep Space Network, soon to be used to facilitate antenna scheduling and to prepare operational pointing and frequency predicts. (SPICE also addresses additional items more closely tied to science instruments.)

Accompanying these SPICE data components is a large suite of software--known as the SPICE Toolkit--used to access the system's data components and to compute many derived quantities. Other SPICE software is used to help produce some SPICE kernels--those that are binary files. The SPICE Toolkit is available in both ANSI FORTRAN 77 and ANSI C. Soon a set of "wrappers" facilitating interfacing to the Interactive Data Language (IDL) will be available.

New data components being added to SPICE include star catalogs (sky catalogs), shape and terrain models, and cartographic control net data. New software is also being added to this system--some associated with the new data types just mentioned, and some providing other new capabilities.

Significant characteristics of the SPICE system are broad applicability, high computational accuracy, portability and stability. SPICE components are carefully designed, highly tested, extensively documented, and freely distributed. One can quickly discern there are no novel algorithms or state-of-the-art technologies within SPICE--the core technology is well understood and has been published worldwide for tens or hundreds of years. But the aforementioned characteristics, while unexciting, make it repeatedly useful to a large community.

Users--whether individuals or project teams--normally build their own SPICE-based applications to solve specific problems. Additionally, a number of groups and companies have built broadly useful SPICE-based applications offered to the space exploration community (sometimes for free, sometimes for a fee); examples are Satellite Orbit Analysis Program[®] (SOAP) by The Aerospace Corporation and Satellite ToolKit[®] (STK) by Analytical Graphics Corporation.

The SPICE system does not include the kinds of core functionality central to the work of astrodynamacists, such as trajectory design, trajectory propagation and orbit estimation. But it can be used to provide astrodynamacists with certain ancillary information often needed in their work, and it can be used as a set of standards for conveying the results of such work to customers for further processing or visualization purposes.

This presentation provides an overview of the current state of the SPICE system, briefly outlines work in progress, and speculates a bit on possibilities for future new capabilities. The presentation also describes typical uses of SPICE. Through participation in this symposium the authors of the SPICE components solicit ideas for broadening the applicability of SPICE, for establishing collaborations on its further development and deployment, and for seeking means to establish substantive and stable interfaces between SPICE and other ancillary information systems.

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